INTRODUCTION TO THE ECE 331 COURSE

ECE 331-INTRODUCTION TO BIOMEDICAL ENGINEERING

Monday, September 8, 2025

COURSE OBJECTIVES

1. To provide an in-depth understanding of anatomy and physiology of the cardiovascular system (heart and blood vessel), the pulmonary system (lung), the renal system, the digestive system, the nervous system, the muscular system and the skeletal system.
2. To introduce learners to:
   a) the origin of biosignals,
   b) fundamentals of heat and mass transfer mechanisms in biological systems,
   c) artificial organs
   d) rehabilitation engineering.

LEARNING OUTCOMES

Upon completion of this course, a student should be able to:

1. **Identify and get an in-depth understanding of anatomy and physiology** of the cardiovascular system (heart and blood vessel), the pulmonary system (lung), the renal system, the digestive system, the nervous system, the muscular system and the skeletal system.
2. **Describe and characterize sources of biomedical signals** and needs of using biomedical instruments.
3. **Apply a broad knowledge of different types of biomaterials** including metals, polymers, ceramics and composites and their use in typical biomedical devices and clinical applications.
4. **Demonstrate an understanding of standards, regulations and ethical responsibilities** in the process of developing biomaterials and medical devices.
5. **Solve conduction, convection and radiation problems in living systems**.

COURSE CONTENT /01

1. **Introduction to Human Physiological Systems**: Musco-skeletal, Cardiovascular Structure and Function, Endocrine System, Nervous System, Vision System, Auditory System, Gastrointestinal System, Respiratory System.

2. **Bioelectric Phenomena:** Basic Electrophysiology, Volume Conductor Theory, Electrical Conductivity of Tissues, Principles of Electrocardiography, Principles of Electromyography, Principles of Electroencephalography, Biomagnetism, Electrical Stimulation of Excitable Systems, Computational Numerical Methods for Bioelectric Field Problems.

3. **Biomaterials:** Metallic Biomaterials, Ceramic Biomaterials, Polymeric Biomaterials, Composite Biomaterials, Biodegradable Polymeric Biomaterials, Tissue Replacements.

COURSE CONTENT /02

4. **Biomechanics:** Musculoskeletal and Soft Tissue Mechanics, Joint-Articulating Surface Motion, Mechanics of Blood Vessel, Cellular Biomechanics.

5. **Heat transfer in living systems:** Energy production in the body or metabolism; Heat transfer within the body - Bioheat transfer or Pennes equation, Influence of blood vessels on heat propagation; Modified bioheat equations Loss of heat from the body - Radiation heat loss, Convection heat loss, Evaporation heat loss, Heat lost by sweat secretion, Respiration heat loss, Conduction heat loss.

6. **Rehabilitation Engineering:** Rehabilitation for locomotion, visual, speech/hearing, artificial limbs, heart valves; externally powered and controlled prosthesis and orthotics.

COURSE ASSESSMENT & TEXTBOOKS

Course Assessment

Continuous assessment: 40%

Written Examination: 60%

Recommended Textbook

1. G.S. Sawhney, **Fundamentals of Biomedical Engineering**, New Age International Publisher, 2007, ISBN-10 : 8122421024, ISBN-13 : 978-8122421026
2. Joseph D. Bronzino, **Biomedical Engineering Fundamentals**, CRC Press (2006)

WHAT IS BIOMEDICAL ENGINEERING?

1. **Biomedical engineering or medical engineering** is the application of engineering principles and design concepts to medicine and biology for healthcare applications.
2. **Biomedical engineers** typically do the following:
   a) Design equipment and devices, such as artificial internal organs, replacements for body parts, and machines for diagnosing medical problems.
   b) Install, maintain, or provide technical support for biomedical equipment.